Evaluation Of Water Quality Impacts Associated With FMC And Simplot Phosphate Ore Processing Facilities, Pocatello, Idaho





Department of Environmental Quality Technical Services Division January 2004

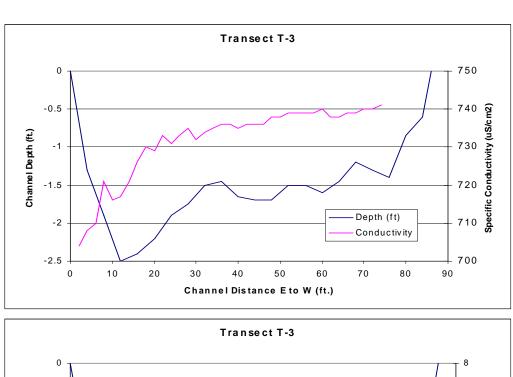
List of Figures

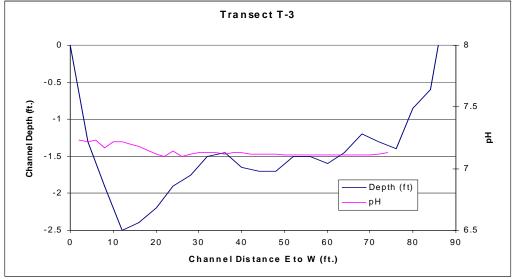
1. Air photo showing features in the East Michaud Flat and FMC/Simplot study area	59
2. Locations of deep and shallow monitoring wells and production wells at the FMC/Simplot site. (Adapted from Bechtel Environmental Inc., June 1994.)	60
3. Potentiometric map of the lower Bannock Creek and Michaud Flats areas, showing location of the East Michaud Flats study area (modified from Spinazola and Higgs, 1998, figure 11)	61
 Ground water flow directions for aquifers east and west of the Portneuf River. Flow directions based on potentiometric maps from West and Kilburn, 1976, Plate 1, Jacobson, 1982, and Bechtel Environmental, Inc., June 1994. 	62
5. Potentiometric map for the shallow aquifer for the FMC/Simplot site. Shaded region represents area where American Falls Lake Beds are absent. Shallow and deep aquifers are combined in shaded area. (Adapted from Bechtel Environmental Inc., 1994.)	63
6. Areal variation in maximum boulder size in the Michaud gravels with contours in feet of longest dimension of largest boulders. (Adapted from Trimble, 1976, figure 13.)	64
7. Transect locations sampled along the Portneuf River on September 13 and 14, 2000. Also shown are five Batiste Spring channel locations sampled from May 4, 1999 through December 7, 2000.	65
8. Discharge, ammonia, nitrite/nitrate, total phosphorus, and orthophosphate concentrations for Portneuf River transects sampled September 13-14, 2000	66
9. Location of reconnaissance transects R-1 through R-4 and additional transects T-1A through T-2B established along the Portneuf River during October 2001	67
10. Portneuf River transect T-1A showing Specific Conductivity, pH, and dissolved oxygen measurements versus east to west channel distance.	68
11. Portneuf River transect T-1B showing Specific Conductivity, pH, and dissolved oxygen versus east to west channel distance.	69
12. Portneuf River transect T-2 showing Specific Conductivity, pH, and dissolved oxygen versus east to west channel distance.	70
13. Portneuf River transect T-2A showing Specific Conductivity, pH, and dissolved oxygen versus east to west channel distance.	71
14. Portneuf River transect T-2B showing Specific Conductivity, pH, and dissolved oxygen versus east to west channel distance.	72
15. Portneuf River transect T-3 showing Specific Conductivity, pH, and dissolved oxygen versus east to west channel distance.	73
16. Station ID (Township, Range and Section) for 13 statewide monitoring wells in the vicinity of the Eastern Michaud Flats area. Triangles show locations of public water supply system (PWS) wells	74
17. Water quality parameters for five sample locations along Batiste Spring channel, November 8, 2000.	75

18.	Portneuf River. Locations for monitoring wells 509, 511 and 513 are shown for Swanson acreage. (Adapted from Cascade Earth Sciences, May 20, 1998.)	76
19.	Site-wide orthophosphate concentrations in the shallow aquifer based on sampling conducted in December 1993	77
20.	Site-wide nitrate concentrations in the shallow aquifer based on sampling conducted in December 1993.	78
21.	Ground water flowpaths for phosphorous loading calculations. American Falls Lake Beds are absent and shallow and deep aquifers are combined in the shaded area. (Adapted from Bechtel Environmental, Inc., 1994.)	79
22.	Discharge and loading, in pounds per day, for total nitrogen, total phosphorous, ammonia, and nitrite/nitrate for Portneuf River transects sampled September 13-14, 2000	80
23.	δ ¹⁸ O versus δ ² H for samples collected from springs and the Portneuf River, and from industrial ponds. (Portneuf R-2001 includes transects T-1A, T-1B, T-2, T-2A and T-2B.)	81
24.	$\delta^{34}S$ versus sulfate concentration for samples from the Portneuf River, springs and a City of Pocatello well.	82
25.	Major ion composition of water from Portneuf River, springs, adjacent shallow ground water, and regional ground water.	83
26.	FMC and Simplot orthophosphate source area ground water concentrations and time trends	84
27.	Major ion composition of water samples from Portneuf River, springs, and selected wells from beneath FMC and Simplot facilities.	85
28.	Orthophosphate concentration vs. sulfate/chloride ratio in water from Portneuf River, springs, and selected wells on FMC and Simplot facilities.	86
29.	Orthophosphate vs. sulfate concentration in water from Portneuf River, springs, and selected wells on FMC and Simplot facilities	87
30.	Orthophosphate vs. chloride concentration in water from Portneuf River, springs, and selected wells on FMC and Simplot facilities	88
31.	Selenium concentration in ground water in the Joint Fenceline area.	89
32.	Orthophosphate concentration in ground water in the Joint Fenceline area	90
	Selenium Concentration Time Trends in Groundwater from Selected FMC Wells in the Joint Fenceline Area	
34.	Orthophosphate concentration time trends in ground water from selected FMC and Simplot wells in the Joint Fenceline area.	92
35.	Potassium concentration in ground water in the Joint Fenceline area	
	Potassium concentration time trends in ground water from selected FMC and Simplot wells in the Joint Fenceline area.	
37.	Chloride concentration in ground water in the Joint Fenceline area.	95

38. Potassium concentration time trends in ground water from selected FMC and Simplot wells in the Joint Fenceline area.	96
39. Monitoring wells, generalized shallow ground water contours, and locations of example flowpaths.	97
40. Solubility diagram of calcium phosphate minerals. Reproduction of Figure 12.9 from Lindsay (1979).	98
41. Relationship of groundwater orthophosphate concentration to calcium activity and pH along simplot and FMC flowpaths	99
42. Groundwater pH time trends in selected FMC and Simplot facility wells	100

FIGURES





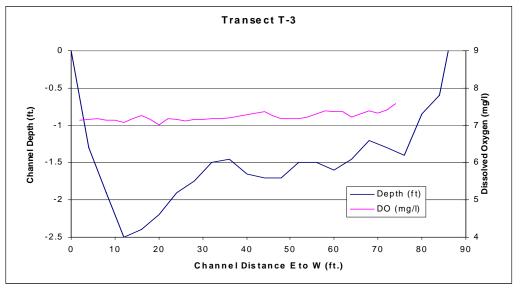


Figure 15. Portneuf River transect T-3 showing Specific Conductivity, pH, and dissolved oxygen versus east to west channel distance.

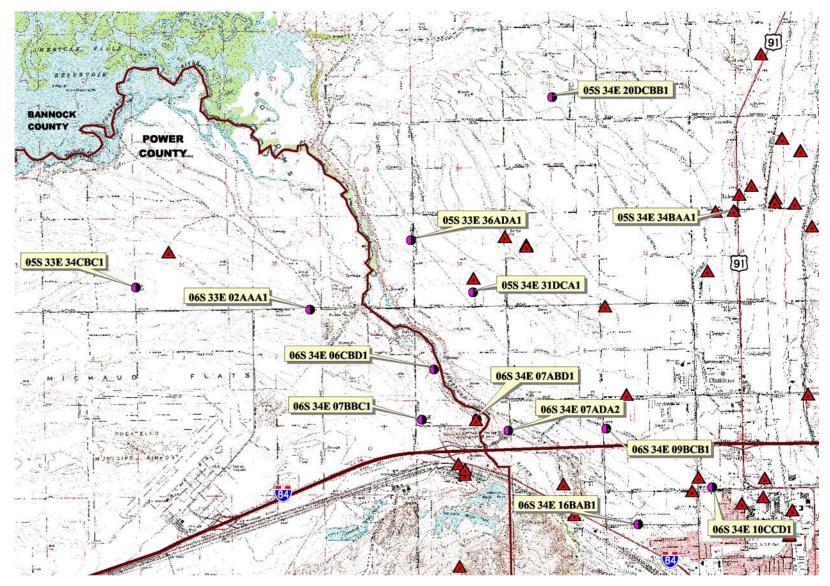
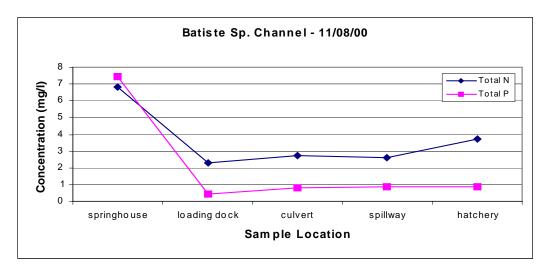
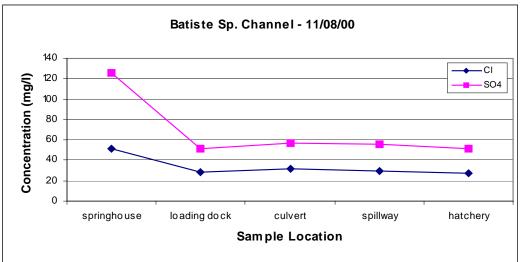


Figure 16. Station ID (Township, Range and Section) for 13 statewide monitoring wells in the vicinity of the Eastern Michaud Flats area. Triangles show locations of public water supply system (PWS) wells.





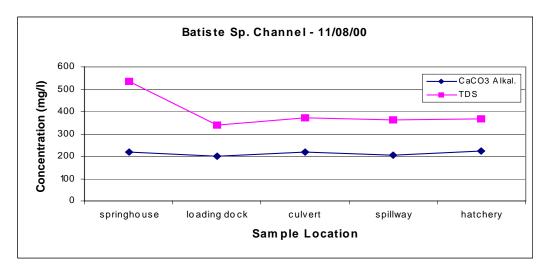


Figure 17. Water quality parameters for five sample locations along Batiste Spring channel, November 8, 2000.

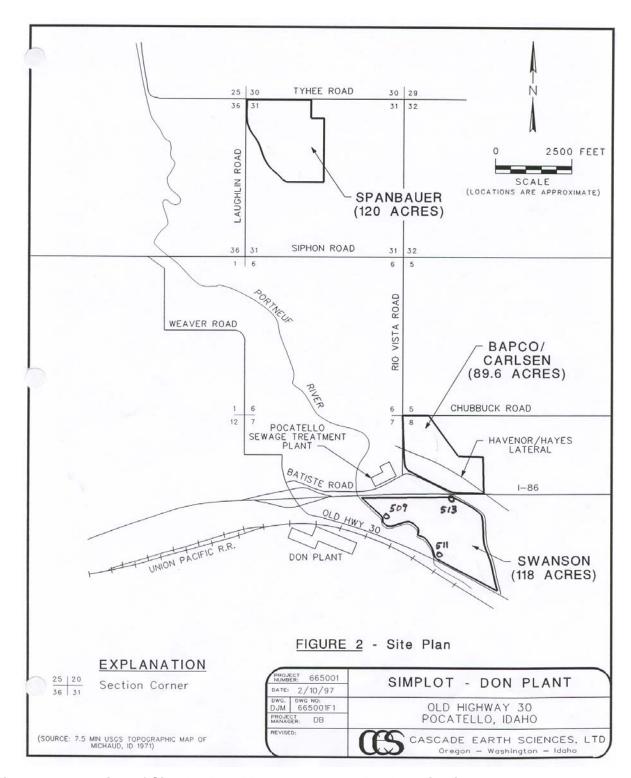


Figure 18. Location of Simplot Don Plant wastewater land application acreage on east side of Portneuf River. Locations for monitoring wells 509, 511 and 513 are shown for Swanson acreage. (Adapted from Cascade Earth Sciences, May 20, 1998.)

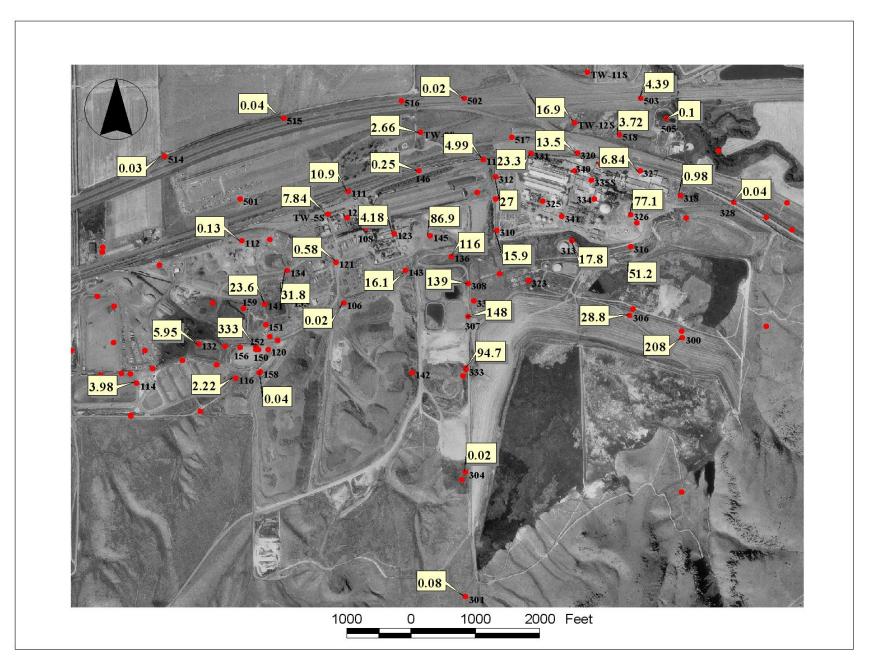


Figure 19. Site-wide orthophosphate concentrations in the shallow aquifer based on sampling conducted in December 1993.

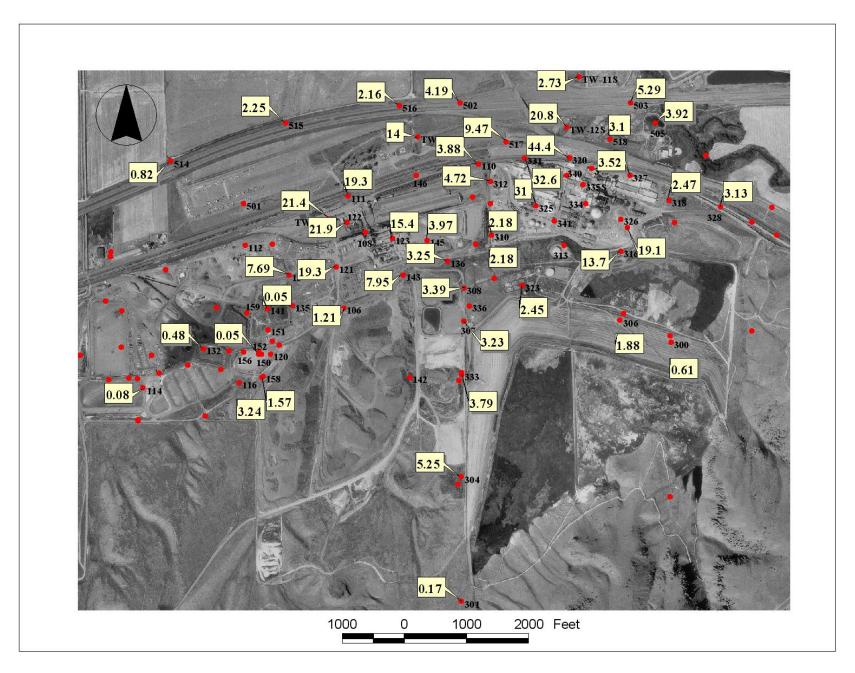


Figure 20. Site-wide nitrate concentrations in the shallow aquifer based on sampling conducted in December 1993.

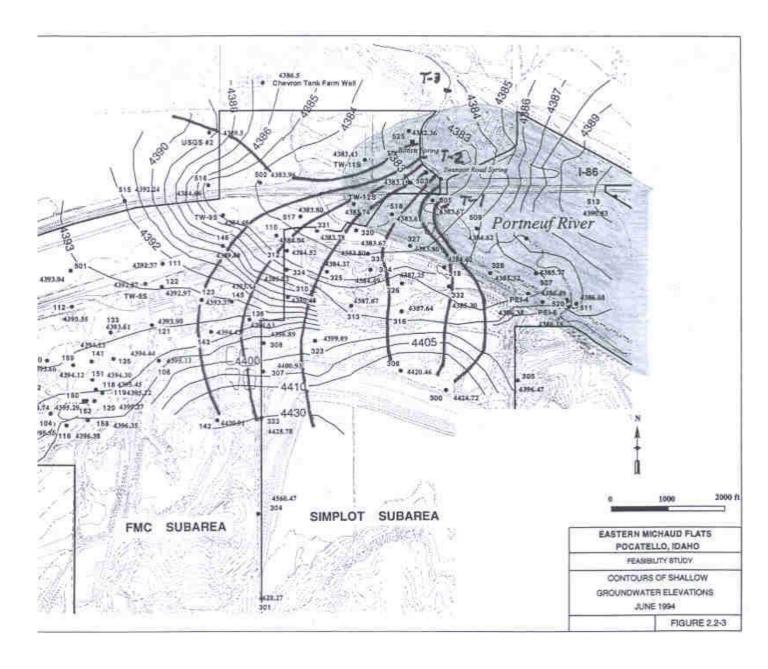
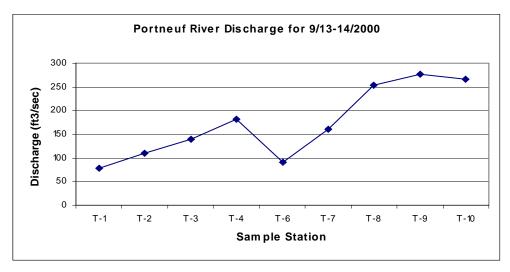
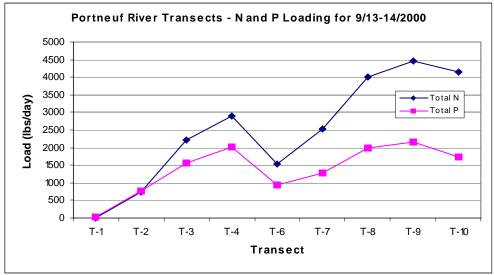


Figure 21. Ground water flowpaths for phosphorous loading calculations. American Falls Lake Beds are absent and shallow and deep aquifers are combined in the shaded area. (Adapted from Bechtel Environmental, Inc., 1994.)





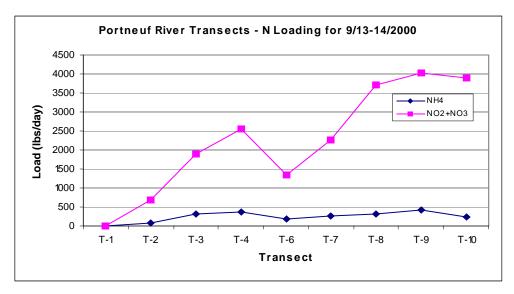


Figure 22. Discharge and loading, in pounds per day, for total nitrogen, total phosphorous, ammonia, and nitrite/nitrate for Portneuf River transects sampled September 13-14, 2000.

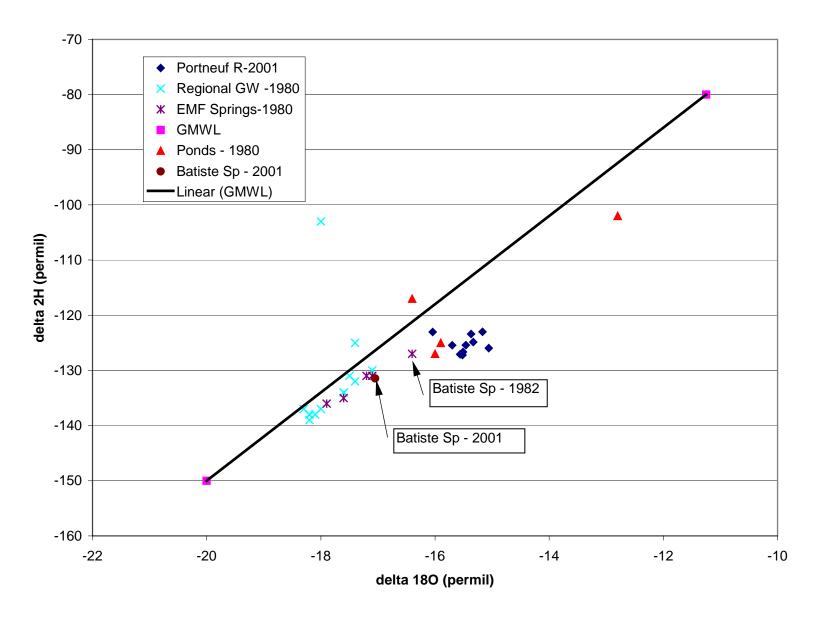


Figure 23. δ^{18} O versus δ^{2} H for samples collected from springs and the Portneuf River, and from industrial ponds. (Portneuf R-2001 includes transects T-1A, T-1B, T-2, T-2A and T-2B.)

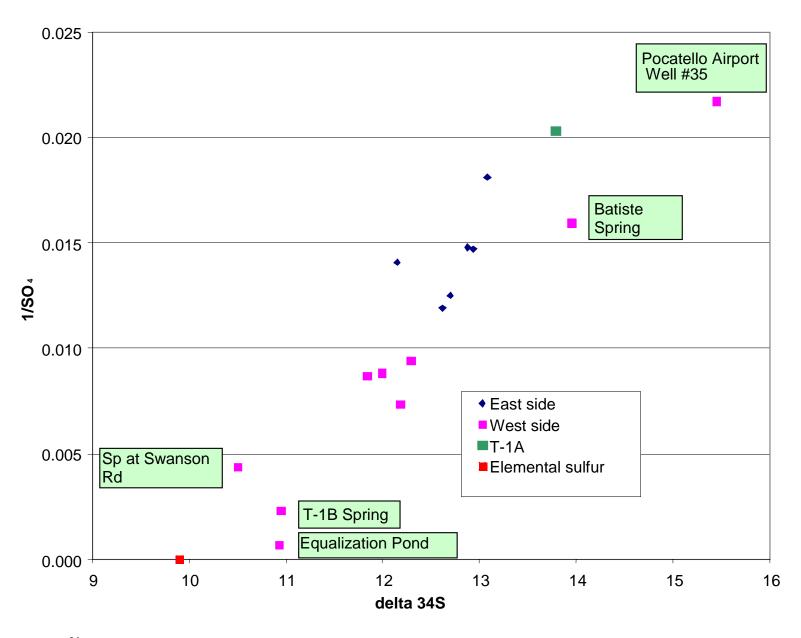


Figure 24. δ^{34} S versus sulfate concentration for samples from the Portneuf River, springs and a City of Pocatello well.

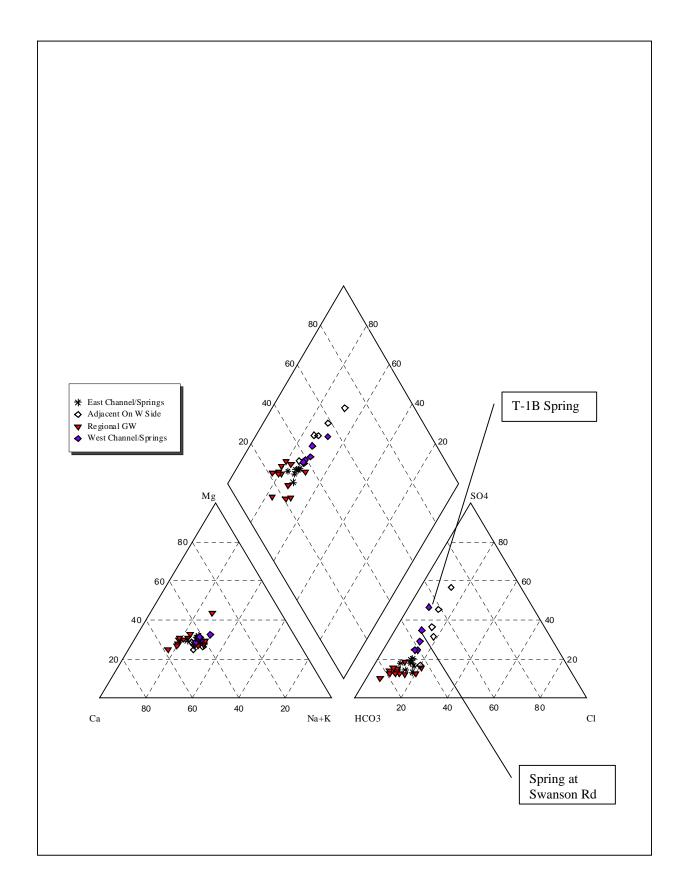
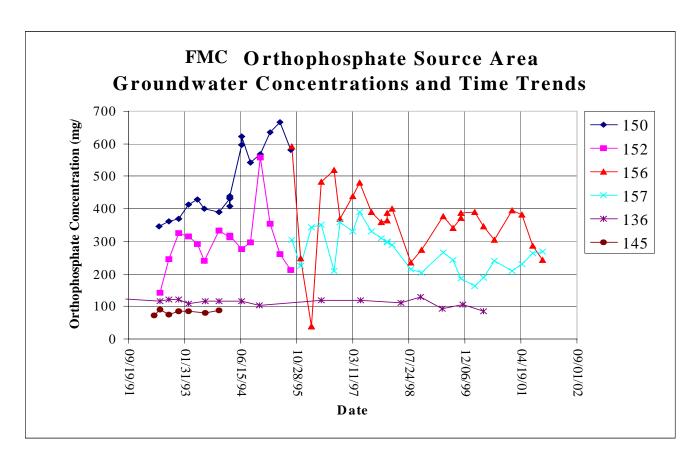


Figure 25. Major ion composition of water from Portneuf River, springs, adjacent shallow ground water, and regional ground water.



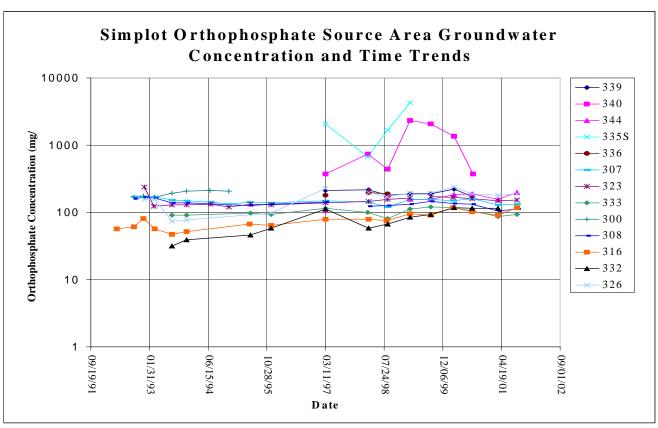


Figure 26. FMC and Simplot orthophosphate source area ground water concentrations and time trends.

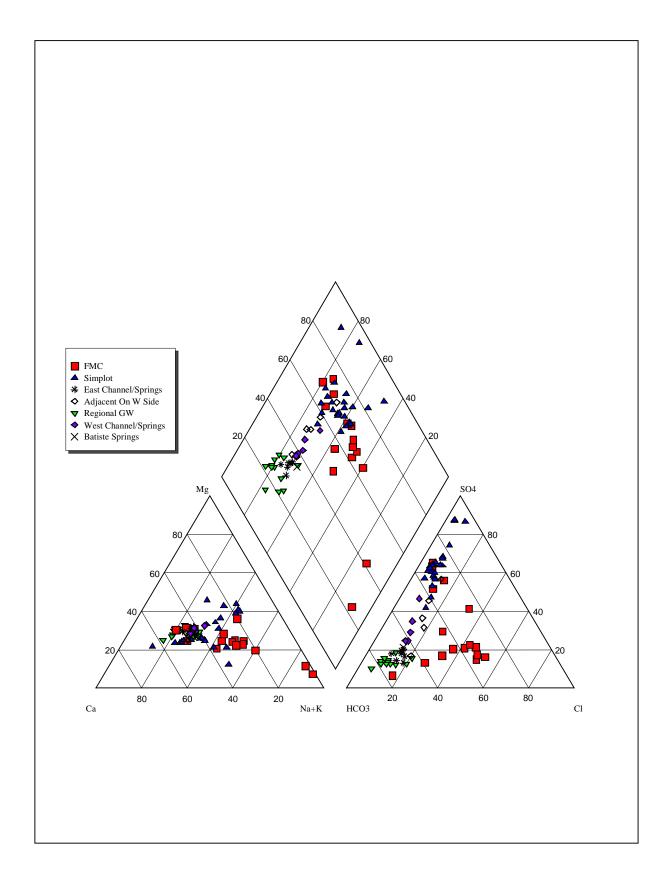


Figure 27. Major ion composition of water samples from Portneuf River, springs, and selected wells from beneath FMC and Simplot facilities.

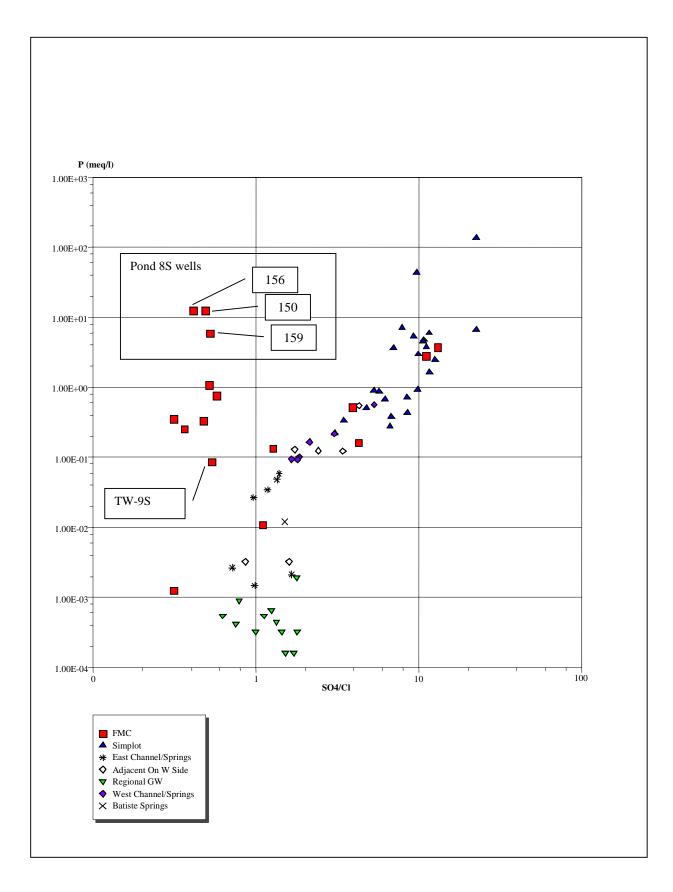


Figure 28. Orthophosphate concentration vs. sulfate/chloride ratio in water from Portneuf River, springs, and selected wells on FMC and Simplot facilities.